PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 0110711027AF	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/IB2005/050789	International filing date *(day/month/year)* 03.03.2005	Priority date *(day/month/year)* 05.03.2004
International Patent Classification (IPC) or national classification and IPC INV. H04N1/195 H04N1/04		
Applicant HORVÁTH, Zoltán et al.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 6 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

Date of submission of the demand	Date of completion of this report
04.10.2005	06.06.2006
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer Azaustre Maleno, V Telephone No. +31 70 340-4147

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IB2005/050789

Box No. I Basis of the report

1. With regard to the **language**, this report is based on

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3(a) and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4(a))
   - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-5, 9-11	as originally filed
6-8	received on 04.04.2006 with letter of 28.03.2006

Claims, Numbers

1-10	received on 04.04.2006 with letter of 28.03.2006

Drawings, Sheets

2, 3	as originally filed
1	received on 01.03.2006 with letter of 01.03.2006

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-10
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-10
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-10
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Reference is made to the following document:

D1: US-A-3 712 729 (O BRIEN J,US) 23 January 1973 (1973-01-23)

Document D1, which is considered to represent the most relevant state of the art, discloses (cf. abstract) a method and apparatus for imaging a target from which the subject-matter of claims 1 and 10 differs in that the optical unit and the optical recording means are displaced a predetermined angle away from the optical axis in order to avoid undesired reflections.

The subject-matter of claims 1 and 10 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as the appearance of undesired reflections and distortions when scanning facing pages of documents such as old books.

The solution to this problem proposed in claims 1 and 10 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

D1 suggests avoiding reflections by means of an anti-reflecting coating in the optical unit and does not address the alternative of displacing both optical unit and optical recording means a predetermined angle away from the optical axis in order to avoid undesired reflections.

Claims 2-9 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

for influencing the direction of rays of light falling onto it, a light source illuminating the target and optical recording means directed to the optical unit, wherein while being directed to the optical unit the optical recording means is positioned in a way that it is turned away and displaced in a receding manner from the plane of the target at a predetermined angle in a curved course compared to the optical axis originating from the centre of the target and originally running at an angle of 45° to the surface of the target, while the mirror is tilted to a rate which is increased by a half of the displacement angle of the optical recording means.

Advantageous Effects

[28] The major advantages of the proposed method are that, firstly, it enables the scanning of physically sensitive documents of limited movability i.e., old books and codices in a way that they are to be opened at an angle of much less than 60° while offering a scanned image of practically free from distortions and even more importantly, from reflections and ghost images. The proposed method and arrangement is less stereoscopic so it can also be applied for mapping and scanning 3D type objects without any further auxiliary measures.

Description of Drawings

[29] Features and advantages of the invention will be apparent from the following description of preferred embodiment, given for the purpose of disclosure and taken in conjunction with the accompanying drawings wherein

[30] Figure 1A, 1B show the theoretical diagram of the course of light of the reflected image of a target on the focal plane of a camera acting as optical recording means in real and developed perspective;

[31] Figure 2A, 2B show the reflected image of a target recorded with a prior art method;

[32] Figure 3A, 3B show the reflected image of an object in real and developed perspective according to the proposed invention;

[33] Figure 4 shows a possible embodiment of an arrangement effecting the proposed method; and

[34] Figure 5 shows a schematic diagram of the arrangement of Figure 4 applied for two-page scanning.

Best Mode

[35] Figure 1A shows a well-known basic situation. It is assumed, that target T represented by an arrow is not reflective and image I is transferred to a point R representing an optical recording means e.g. a camera by means of mirror M acting as an optical unit positioned on a plane extending in an angle of 45° to the plane of target T.

[36] Figure 1B shows a developed light path. In fact, this is the way how a camera or the human eyes see the image. The dotted line represents the at least one reflecting surface which can not be seen from point R (i.e. from the position of the camera). The target T to be imaged should be positioned in a way that an optical axis OA of the im-

aging originated from point R and refracted on intermediate reflecting surfaces RS finally passes through the focal point of the target T while being at right angles to its surface. This arrangement ensures an imaging of the least distortion.

[37] Figure 2A shows a variant of the above arrangement wherein even target T itself (or the pressing-down element i.e. glass) is reflective. Figure 2B shows that the mapped image I of target T is at the same place like in Figure 1B but here there is also a ghost image GI below as a result of the threefold reflection (it is reflected twice on mirror M and in the meantime once on its own gleaming reflected surface RS, see the reflected dotted lines in Figure 2A). The shaded area represents empty areas EA excluded from the field of vision. It should be noted that the ghost image GI appearing as a vague and flat image of target T under its real image I falls fully within the field of vision.

[38] Figures 3A and 3B show a scenario where a point R1 representing the camera is displaced from its usual position (i.e., point R) shown in the previous Figures in a way that it is shifted away from the original optical axis OA in a curved course with an angle α, at the same time properly turned around its own axis in order to continuing facing the mirror M that is also tilted with half of the angle ($\alpha/2$) of the displacement of point R into point R1. The actual optical axis OA passes through the focal point of target T at right angles to its surface even in this case, and the mirror M should also be tilted with half of the angle ($\alpha/2$) of the displacement of point R. For better understanding Figure 3A shows said scenario in a somewhat distorted way wherein the original optical path is indicated by dotted lines and the modified optical path is indicated with broken lines.

[39] It can be seen that the ghost image GI being the result of the manifold reflections now falls to the shaded empty area EA, i.e. outside the field of vision of the optical recording means.

[40] In case the point R1 representing the new position of the camera is displaced to the opposite direction compared to the optical axis OA originating from the focal point of the target T (downwards according to the Figure), ghost image GI will fall even more within the field of vision, so this option can and should be ignored.

[41] Consequently, if the optical recording means is displaced upwards compared to the optical axis OA positioned at a theoretical angle of 90° in Figure 1A with an angle α corresponding to half of the visual angle of the camera, while in order to retain the right angle perspective the mirror M is displaced from the theoretical angle of 45° with an angle corresponding to the half of the angle α of the above-mentioned displacement, then the targets requiring strong illumination and their reflected (and manifold reflected) virtual images will fall out of the field of vision of the camera, while areas S which can be held dark with known measures, will fall within, so they will not disturb the image I. Moreover, with the angles of vision practically used by this arrangement an empty space ES is created, the image of which is never brought into the field of

vision of the camera by any initial or superior reflections, and the illuminating light sources can be optionally placed, (see Figure 4). Through their proper setting a homogeneous illumination can be provided.

[42] There are several practical options to implement the above-described solution. In the simplest case an arrangement can be set up which enables to scan and image the target T, e.g. one page of an opened book, by means of assembling a pressing glass plate G and a surface mirror M at the proper angle and of the proper placement of the camera as well as the light sources and by means of covering the spaces which are sensitive from the point of view of ghost image creation with some dark material.

[43] Figure 4 shows one of the preferred embodiments. Calculating with the parameters of a commercially available photo camera (e.g., Leica) in case of a lens with a focal distance of 80 mm the total length of the optical way required by taking a image of an A4 page is 700 mm where the angle of vision of the objective is 17°. Based on the above-mentioned considerations the point R of the camera should be raised by at least $\alpha = 8{,}5°$ compared to the optical axis OA extending at right angles to the surface of target T. In fact, the use of a somewhat greater angle, e.g. $\alpha = 10°$ is recommended. In this case the mirror M should be tilted upwards with an angle of 5°. In this arrangement a book corresponding to target T should be opened only at an angle of 50° which means a substantially more tolerant handling from the point of view of the book. With the proper selection of the camera, when the above-mentioned considerations are also taken into respect, the opening angle of the book can be further reduced, which rate is constrained only be the physical dimensions of the mirror M to be inserted between the pages of the book.

[44] According to a further preferred implementation the book intended to be scanned is placed onto the surface of a wedge-shaped optical unit, where one of its sides is a pressing-down glass plate G, while the other is the mirror M.

[45] In case the thicknesses of both the mirror M and the pressing-down glass plate G are 3 mm, it can be easily calculated that the parts of target T situated at 6 mm inwards from the outer edge of the wedge formed by M and G will already appear on the scanned image I.

[46] Since there is only one mirror M placed in the course of light, the image I will be reversed compared to target T, but with the modern digital processing systems it can be easily corrected by some software or hardware solutions.

[47] The basic material of the pressing-down glass plate G and mirror M can be plane-parallel optical glass of the type BK7 but some better quality float (window) glass is also suffice. Mirror M is preferably a surface mirror with its reflecting layer situated on the external face of the basic glass plate. Such mirrors widely used at optical applications are produced and dressed e.g. by Unioptik Ltd., Hungary. By this solution

Claims

[1] **1.** A method for imaging a primarily two-dimensional target (T), comprising the steps matching at least one optical unit (M) adapted for influencing the direction of rays of light falling onto it with the target (T); illuminating the target (T) while directing an optical recording means to the optical unit (M), mapping the points of the target (T) reaching the optical recording means through the optical unit by projecting the rays originating from the points of the target (T) at right angles to the target (T) through the optical unit (M) to sensor means of the optical recording means in the whole range of the optical angle of the optical recording means, ***characterized by*** displacing the optical recording means from its usual position at the optical axis (OA) originating from the centre of the target (T) with a predetermined angle α in a direction away from the plane of the target (T) while maintaining the distance between a mirror (M) used as the optical unit and the optical recording means, and tilting the mirror (M) half to the extent of said displacement – i.e. with an angle $\alpha/2$ – of the optical recording means.

2. A method according to claim 1, ***characterized by*** pressing down the surface of the target (T) to gain flat surface for mapping.

3. A method according to claim 1 or 2, ***characterized by*** choosing the value of the angle α exceeding at least the half of the optical angle of the optical recording means.

4. A method according to claim 3, ***characterized by*** using a surface mirror (M) as the optical unit.

5. A method according to any of claims 1 to 4, ***characterized by*** using a wedge-shaped optical unit composed of a pressing-down glass plate (G) and a surface mirror (M).

6. A method according to claim 5, ***characterized by*** using an optical unit with adjustable front rake.

7. A method according to any of claims 1 to 6, ***characterized by*** scanning both pages of the opened book (B) used as the target (T) consecutively by a mirror (M) embedded into the wedge-shaped optical unit so that it can be tilted, but without removing the wedge-shaped optical unit from between the glass plates (G) constituting its boundaries.

8. A method according to any of claims 1 to 7, ***characterized by*** applying a light source (L) providing homogenous diffused light.

9. A method according to claim 8, ***characterized by*** applying a light source (L) assembled of several discrete light sources.

10. An arrangement for imaging a primarily two-dimensional target (T), including at least one optical unit adapted for influencing the direction of rays of light falling onto it, a light source (L) illuminating the target (T) and optical recording

means directed to the optical unit (M) ***characterized in that*** while being directed to the optical unit (M), the optical recording means is displaced in a new position (R_1) from its usual position (R) at the optical axis (OA) originating from the centre of the target (T) and originally running at an angle of 45° to the surface of the target (T), with a predetermined angle α, in a direction away from the plane of the target (T), while a mirror (M) used as the optical unit is tilted to an extent which is increased by a half of the displacement angle – i.e. with an angle α/2 – of the optical recording means.

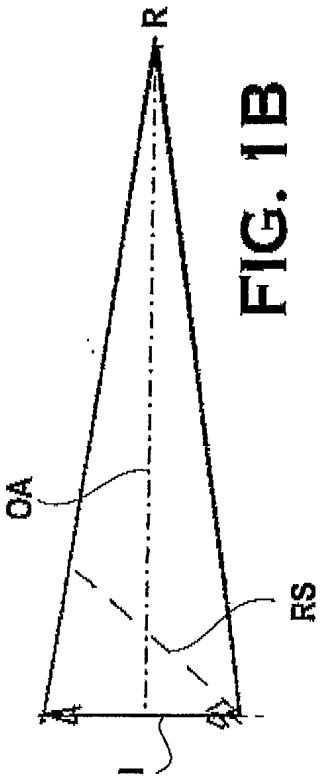

FIG. 1B

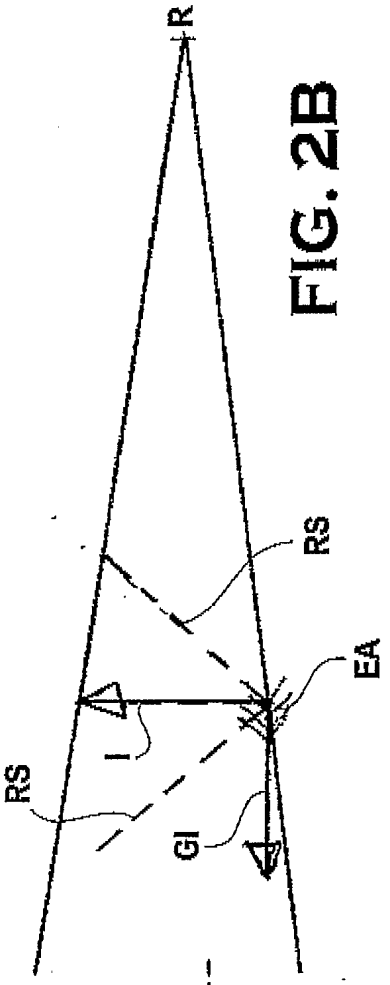

FIG. 2B

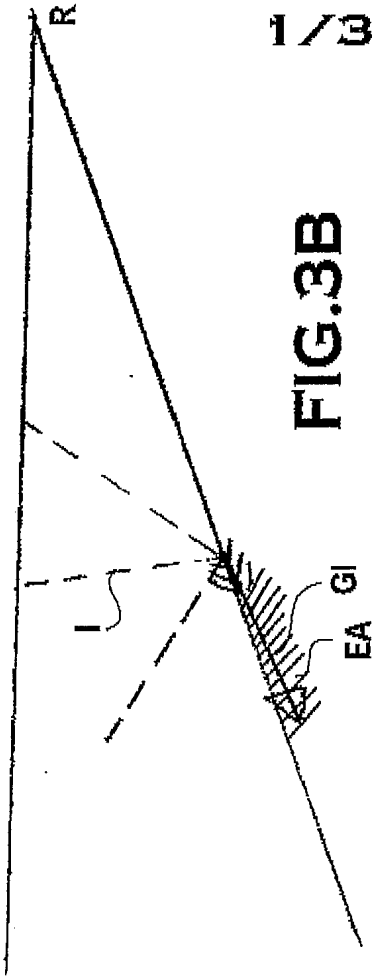

FIG.3B

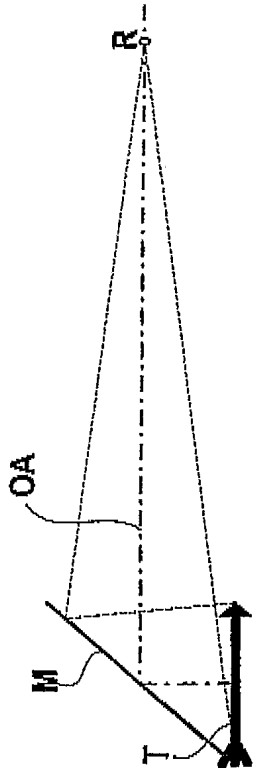

FIG. 1A

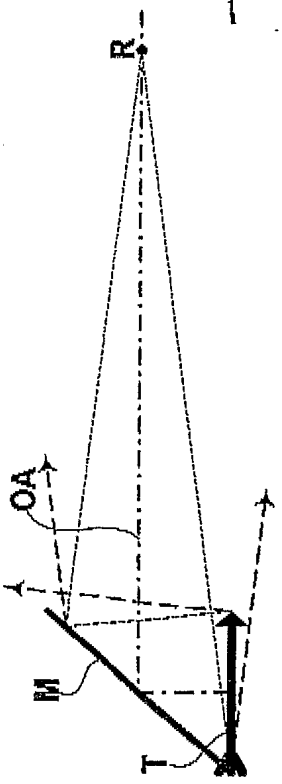

FIG. 2A

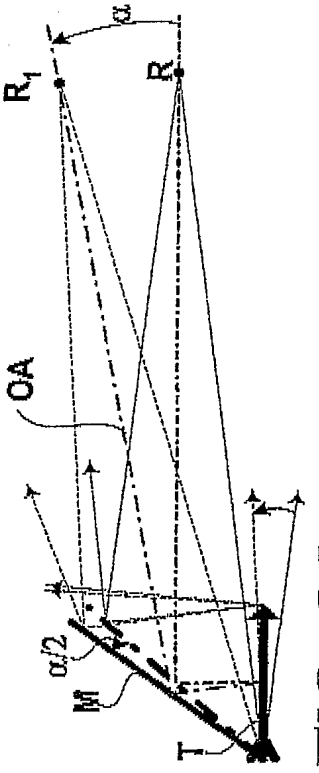

FIG. 3A